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Piute Reservoir
Piute County, Utah

National Eutrophication Survey, Corvallis, Oreg

Prepared for

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NATIONAL EUTROPHICATION SURVEY

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REPORT
ON
PIUTE RESERVOIR
PIUTE COUNTY
UTAH
EPA REGION VIII
WORKING PAPER No. 854

WITH THE COOPERATION OF THE
UTAH STATE DIVISION OF HEALTH
AND THE
UTAH NATIONAL GUARD
NOVEMBER, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Utah Department of Social Services and the Utah Department of Natural Resources for professional involvement, to the Utah National Guard for conducting the tributary sampling phase of the Survey, and to those Utah wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staffs of the Bureau of Water Quality of the Division of Health and the Division of Wildlife Resources provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

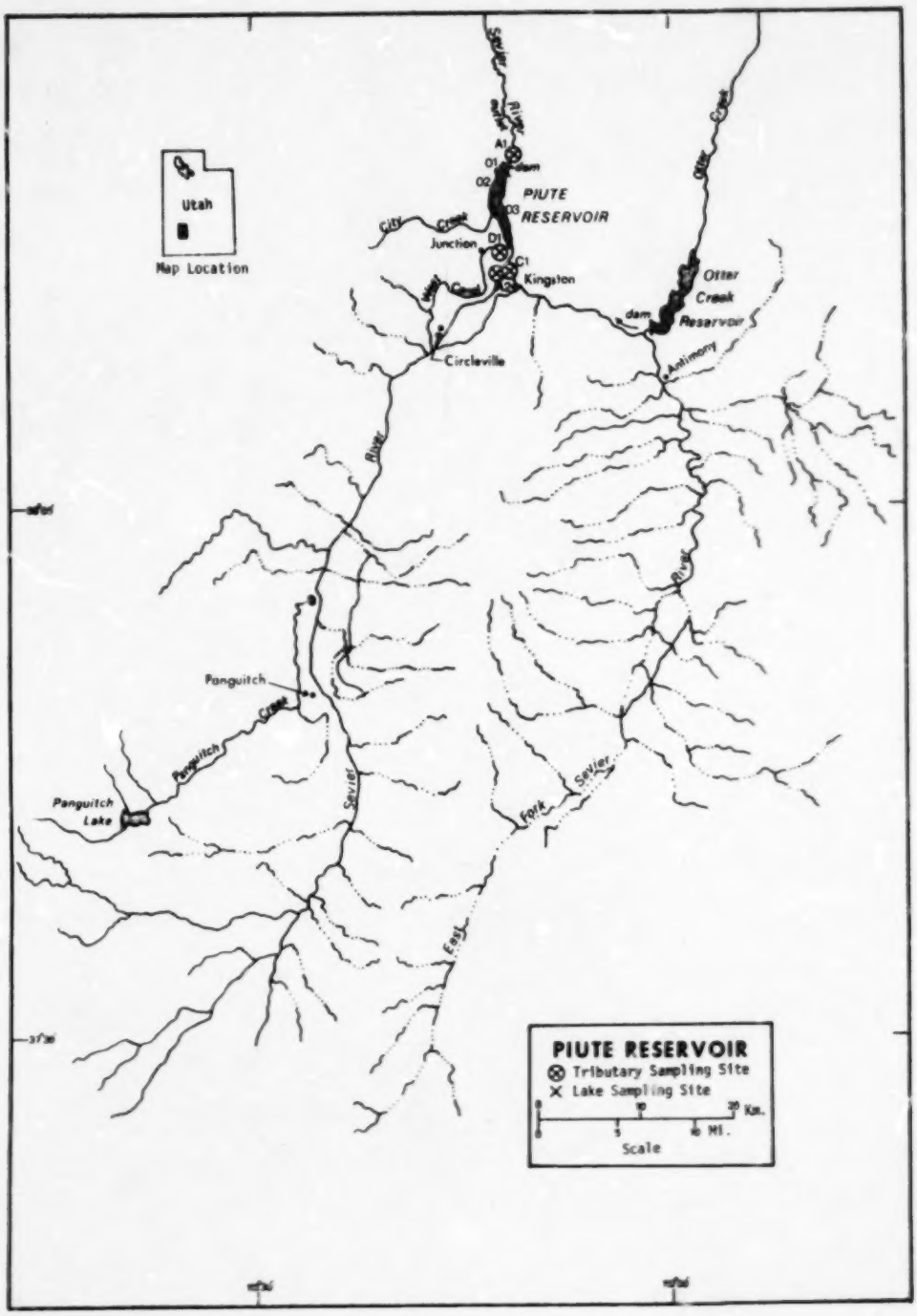
Major General Maurice L. Watts, the Adjutant General of Utah, and Project Officer Lt. Colonel T. Ray Kingston, who directed the volunteer efforts of the Utah National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF UTAH

NAME	COUNTY
Bear	Rich, UT; Bear Lake, ID
Deer Creek	Wasatch
Echo	Summit
Fish	Sevier
Flaming Gorge	Daggett, UT; Sweetwater, WY
Huntington	Emery
Joes Valley	Emery
Lower Bowns	Garfield
Lynn	Box Elder
Minersville	Beaver
Moon	Duchesne
Navajo	Kane
Newcastle	Iron
Otter Creek	Piute
Panguich	Garfield
Pelican	Uintah
Pineview	Weber
Piute	Piute
Porcupine	Cache
Powell	Garfield, Kane, San Juan, UT; Coconino, AZ
Pruess	Millard
Sevier Bridge	Juab, Sanpete
Starvation	Duchesne
Steinaker	Uintah
Tropic	Garfield
Utah	Utah
Willard Bay	Box Elder


Utah
Map Location
Sevier River
A1
O1
O2
O3
dam
PIUTE
RESERVOIR
City Creek
Junction
D1
C1
Kingston
Creek
Circleville
Otter Creek
Otter
Creek
Reservoir
dam
Antimony
River
Panguitch
Creek
Panguitch
Lake
Sevier
Fork
East
PIUTE RESERVOIR
Tributary Sampling Site
Lake Sampling Site
10
20 Km.
5
10 Mi.
Scale

PIUTE RESERVOIR

STORET NO. 4917

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Piute Reservoir is eutrophic. It ranked twenty-third in overall trophic quality when the 27 Utah lakes and reservoirs sampled in 1975 were compared using a combination of six parameters*. Eighteen of the waterbodies had less and one had the same median total phosphorus, 18 had less median inorganic nitrogen, 14 had less and one had the same median dissolved orthophosphorus, 22 had less mean chlorophyll a, and 24 had greater mean Secchi disc transparency. Some depression of dissolved oxygen with depth occurred at sampling station 2 in August (3.4 mg/l at 6.4 meters), and the near-surface concentration at station 1 in September was only 67% of saturation.

Survey limnologists did not report surface concentrations of algae or rooted aquatic plants in the reservoir. However, the rather high chlorophyll a concentrations and numbers of phytoplankton at all sampling stations and times are indicative of bloom or near-bloom conditions (see page 6).

B. Rate Limiting Nutrient:

The results of the algal assay indicate phosphorus limitation in May.

The reservoir data indicate phosphorus limitation in May and August and nitrogen limitation in September.

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No known wastewater treatment plants impacted Piute Reservoir during the sampling year.

The present phosphorus loading of 2.03 $g/m^2/yr$ is nearly three times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11).

2. Non-point sources--Non-point sources, including direct precipitation, contributed all of the total phosphorus load during the sampling year. The Sevier River added 76.0% of the total load; the East Fork Sevier River, 20.0%; West Canal, 0.3%; and the ungaged tributaries contributed an estimated 2.8%.

The phosphorus export rates of the Sevier River and the East Fork Sevier River were relatively low (5 and 1 $kg/km^2/yr$, respectively; see page 10).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 10.15 kilometers^2.
2. Mean depth: 10.1 meters.
3. Maximum depth: 20.1 meters.
4. Volume: 101.516 x 10^6 m^3.
5. Mean hydraulic retention time: 239 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Sevier River	3,185.7	2.860
E. Fk. Sevier River	2,952.6	1.870
West Canal	0.0	0.036
Minor tributaries & immediate drainage -	171.1	0.151
Totals	6,309.4	4.917

2. Outlet -

Sevier River	6,319.6**	4.917

C. Precipitation***:

1. Year of sampling: 20.7 centimeters.
2. Mean annual: 20.7 centimeters.

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† Table of metric equivalents--Appendix B.
†† Sudweeks, 1975.
* For limits of accuracy, see Working Paper No. 175, "... Survey Methods. 1973-1976".
** Includes area of reservoir; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Piute Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations in May and August and two stations in September (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 7.6 meters at station 1, 9.8 meters at station 2, and 2.7 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR PIUTE RESERVOIR
STORET CODE 4917

PARAMETER	1ST SAMPLING (5/ 9/75) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/13/75) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/24/75) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	7.2 - 9.1	7.9	7.7	17.2 - 18.4	17.8	18.0	15.6 - 17.1	16.4	16.4
DISS OXY (MG/L)	8.8 - 10.6	9.6	9.6	3.4 - 6.8	6.1	6.4	5.0 - 9.4	8.0	8.4
CNDCTVY (MCROMO)	321. - 339.	328.	326.	489. - 510.	499.	500.	389. - 402.	396.	396.
PH (STAND UNITS)	8.6 - 8.8	8.7	8.6	8.0 - 8.5	8.4	8.4	8.5 - 8.6	8.6	8.6
TOT ALK (MG/L)	268. - 326.	292.	285.	224. - 292.	255.	256.	146. - 290.	190.	170.
TOT P (MG/L)	0.036 - 0.058	0.041	0.039	0.045 - 0.110	0.061	0.048	0.073 - 0.125	0.091	0.081
ORTHO P (MG/L)	0.004 - 0.010	0.006	0.005	0.006 - 0.045	0.014	0.009	0.006 - 0.010	0.007	0.006
NO2+NO3 (MG/L)	0.150 - 0.200	0.174	0.170	0.020 - 0.720	0.169	0.020	0.020 - 0.050	0.026	0.020
AMMONIA (MG/L)	0.030 - 0.050	0.042	0.040	0.020 - 0.090	0.028	0.020	0.020 - 0.020	0.020	0.020
KJEL N (MG/L)	0.400 - 1.000	0.570	0.500	0.400 - 0.800	0.533	0.500	0.600 - 0.800	0.740	0.800
INORG N (MG/L)	0.190 - 0.250	0.216	0.210	0.040 - 0.740	0.197	0.040	0.040 - 0.070	0.046	0.040
TOTAL N (MG/L)	0.570 - 1.150	0.744	0.690	0.420 - 1.520	0.702	0.520	0.620 - 0.850	0.766	0.820
CHLRPYL A (UG/L)	16.8 - 18.1	17.3	17.0	14.6 - 16.8	15.7	15.7	38.9 - 55.1	47.0	47.0
SECCHI (METERS)	0.5 - 0.6	0.6	0.6	0.2 - 0.6	0.4	0.5	0.2 - 0.3	0.2	0.2

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/09/75	1. Diatoma sp.	10,007
	2. Dinobryon sp.	1,943
	3. Cyclotella sp.	426
	4. Cryptomonas sp.	80
	5. Gymnodinium sp.	80
	Other genera	79
	Total	12,615
08/13/75	1. Mallomonas sp.	489
	2. Cryptomonas sp.	383
	3. Chroomonas (?) sp.	349
	4. Oocystis sp.	70
	5. Staurastrum sp.	70
	Other genera	105
	Total	1,466
09/24/75	1. Cyclotella sp.	1,635
	2. Mallomonas sp.	1,372
	3. Cryptomonas sp.	739
	4. Euglena sp.	369
	5. Schroederia sp.	369
	Other genera	897
	Total	5,381

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/09/75	1	16.8
	2	18.1
	3	17.0
08/13/75	1	16.8
	2	14.6
	3	-
09/24/75	1	55.1
	2	38.9
	3	-

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	< 0.005	0.200	0.2
0.050 P	< 0.055	0.200	8.8
0.050 P + 1.0 N	< 0.055	1.200	20.5
1.0 N	< 0.005	1.200	0.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Piute Reservoir was moderately low when the sample was taken (05/09/75). Also, the lack of increase in yield with the addition of nitrogen alone and the significant increase in yield when only phosphorus was added indicate phosphorus limitation at that time.

The reservoir data indicate phosphorus limitation in May and August and nitrogen limitation in September. The mean inorganic nitrogen to orthophosphorus ratios were 36 to 1 in May, 14 to 1 in August, and 7 to 1 in September.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Utah National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of May when two samples were collected at three of the sites. Sampling was begun in November, 1974, and was completed in October, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Utah District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using the mean annual nutrient concentrations and the mean annual flows. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient concentrations at stations A-2 and C-1 and multiplying the means by the ZZ mean annual flow.

No known municipal wastewater treatment plants impacted Piute Reservoir during the sampling year.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Sevier River	15,695	76.0
E. Fk. Sevier River	4,130	20.0
West Canal	70	0.3
b. Minor tributaries & immediate drainage (non-point load) -	580	2.8
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	180	0.9
Total	20,655	100.0

2. Outputs -

Lake outlet - Sevier River 10,855

3. Net annual P accumulation - 9,800 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Sevier River	170,735	62.3
E. Fk. Sevier	82,855	30.3
West Canal	1,415	0.5
b. Minor tributaries & immediate drainage (non-point load) -	7,850	2.9
c. Known municipal STP's - None	-	-
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation*	10,960	4.0
Total	273,815	100.0

2. Outputs -

Lake outlet - Sevier River 204,370

3. Net annual N accumulation - 69,445 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Sevier River	5	54
E. Fk. Sevier	1	28

E. Mean Nutrient Concentrations in West Canal:

Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
0.061	1.245

* See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	2.03	0.97	27.0	6.8

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Piute Reservoir:

"Dangerous" (eutrophic loading)	0.76
"Permissible" (oligotrophic loading)	0.38

V. LITERATURE REVIEWED

Sudweeks, Calvin K., 1975. Personal communication (lake morphometry). UT Bur. of Env. Health, Salt Lake City.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	590-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0408	LAKE POWELL	0.010	0.410	339.830	3.081	13.800	0.007
4901	BEAR LAKE	0.011	0.040	253.167	0.945	9.200	0.003
4902	LOWER BOWN'S RESERVOIR	0.031	0.040	336.000	5.567	9.400	0.006
4903	DEER CREEK RESERVOIR	0.038	0.215	430.333	9.078	14.800	0.006
4904	ECHO RESERVOIR	0.047	0.170	450.333	6.967	14.000	0.012
4905	LYNN RESERVOIR	0.121	0.288	417.667	39.600	10.400	0.052
4906	FISH LAKE	0.023	0.040	152.000	12.483	10.400	0.004
4907	HUNTINGTON NORTH RESERVO	0.013	0.040	392.000	1.900	7.800	0.005
4908	JOE'S VALLEY RESERVOIR	0.012	0.045	400.000	2.483	11.200	0.003
4909	MINERSVILLE RESERVOIR	0.192	0.060	445.000	33.583	8.600	0.107
4910	MOON LAKE	0.008	0.040	381.000	2.700	9.600	0.002
4911	NAVAJO LAKE	0.016	0.040	368.000	2.000	6.000	0.003
4912	NEWCASTLE RESERVOIR	0.051	0.049	428.667	12.467	13.600	0.009
4913	OTTER CREEK RESERVOIR	0.067	0.049	453.667	11.767	10.600	0.033
4914	PANGUITCH LAKE	0.071	0.040	426.500	45.950	14.200	0.010
4915	PELICAN LAKE	0.044	0.050	438.500	6.350	8.400	0.004
4916	PINEVIEW RESERVOIR	0.028	0.308	439.083	5.692	14.600	0.006
4917	PIUTE RESERVOIR	0.047	0.150	482.625	25.329	11.600	0.007
4918	PORCUPINE RESERVOIR	0.025	0.110	440.000	7.860	12.400	0.011
4919	PRUESS RESERVOIR (GARRIS	0.057	0.140	491.000	4.533	8.800	0.008
4920	SEVIER BRIDGE RESERVOIR	0.026	0.355	449.778	18.222	12.400	0.008
4921	STARVATION RESERVOIR	0.016	0.040	394.583	5.675	13.200	0.004
4922	STEINAKER RESERVOIR	0.011	0.040	316.750	1.844	12.600	0.005
4923	TROPIC RESERVOIR	0.021	0.050	425.000	7.200	8.400	0.006
4924	UTAH LAKE	0.132	0.320	490.583	72.012	11.400	0.012
4925	WILLARD BAY RESERVOIR	0.044	0.060	457.182	7.567	11.000	0.009
5605	FLAMING GORGE RESERVOIR	0.011	0.690	285.636	2.500	10.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN OD	MEDIAN DISS ORTHO P	INDEX NO
4908	LAKE POWELL	96 (25)	4 (1)	81 (21)	73 (19)	15 (4)	42 (11)	311
4901	BEAR LAKE	90 (23)	87 (19)	96 (25)	100 (26)	77 (20)	90 (23)	540
4902	LOWER BOWN'S RESERVOIR	46 (12)	87 (19)	85 (22)	65 (17)	73 (19)	53 (13)	406
4903	DEER CREEK RESERVOIR	42 (11)	19 (5)	42 (11)	35 (9)	0 (0)	58 (14)	196
4904	ECHO RESERVOIR	31 (8)	27 (7)	19 (5)	50 (13)	12 (3)	13 (3)	152
4905	LYNN RESERVOIR	8 (2)	23 (6)	58 (15)	8 (2)	62 (15)	4 (1)	163
4906	FISH LAKE	62 (16)	65 (16)	100 (26)	23 (6)	62 (15)	79 (20)	341
4907	HUNTINGTON NORTH RESERVO	77 (20)	65 (16)	69 (18)	92 (24)	96 (25)	69 (18)	468
4908	JOE'S VALLEY RESERVOIR	81 (21)	58 (15)	62 (16)	85 (22)	46 (12)	96 (25)	428
4909	MINERSVILLE RESERVOIR	0 (0)	44 (11)	27 (7)	12 (3)	85 (22)	0 (0)	168
4910	MOON LAKE	100 (26)	87 (19)	73 (19)	77 (20)	69 (18)	100 (26)	506
4911	NAVAJO LAKE	69 (18)	87 (19)	77 (20)	88 (23)	100 (26)	85 (22)	506
4912	NEWCASTLE RESERVOIR	23 (6)	87 (19)	46 (12)	27 (7)	19 (5)	27 (7)	229
4913	OTTER CREEK RESERVOIR	15 (4)	87 (19)	15 (4)	31 (8)	54 (14)	8 (2)	210
4914	PANGUITCH LAKE	12 (3)	65 (16)	50 (13)	4 (1)	8 (2)	23 (6)	162
4915	PELICAN LAKE	37 (9)	84 (14)	38 (9)	54 (14)	90 (23)	73 (19)	343
4916	PINEVIEW RESERVOIR	50 (13)	15 (4)	38 (10)	58 (15)	4 (1)	58 (14)	223
4917	PIUTE RESERVOIR	27 (7)	31 (8)	8 (2)	15 (4)	38 (10)	46 (12)	165
4918	PORCUPINE RESERVOIR	58 (15)	38 (10)	31 (8)	38 (10)	33 (8)	19 (5)	217
4919	PRUESS RESERVOIR (GARRIS	19 (5)	35 (9)	0 (0)	69 (18)	81 (21)	37 (9)	241
4920	SEVIER BRIDGE RESERVOIR	54 (14)	8 (2)	23 (6)	19 (5)	33 (8)	37 (9)	174
4921	STARVATION RESERVOIR	73 (19)	87 (19)	65 (17)	62 (16)	23 (6)	79 (20)	389
4922	STEINAKER RESERVOIR	85 (22)	87 (19)	88 (23)	96 (25)	27 (7)	65 (17)	448
4923	TROPIC RESERVOIR	65 (17)	50 (13)	54 (14)	46 (12)	90 (23)	58 (14)	363
4924	UTAH LAKE	4 (1)	12 (3)	4 (1)	0 (0)	42 (11)	13 (3)	75
4925	WILLARD BAY RESERVOIR	37 (9)	44 (11)	12 (3)	42 (11)	58 (15)	31 (8)	216
5605	FLAMING GORGE RESERVOIR	90 (23)	0 (0)	92 (24)	81 (21)	62 (15)	90 (23)	415

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4901	BEAR LAKE	548
2	4911	NAVAJO LAKE	506
3	4910	MOON LAKE	506
4	4907	HUNTINGTON NORTH RESERVO	468
5	4922	STEINAKER RESERVOIR	448
6	4908	JOE'S VALLEY RESERVOIR	428
7	5605	FLAMING GORGE RESERVOIR	415
8	4902	LOWER BOWN'S RESERVOIR	406
9	4906	FISH LAKE	391
10	4921	STARVATION RESERVOIR	389
11	4923	TROPIC RESERVOIR	363
12	4915	PELICAN LAKE	343
13	0408	LAKE POWELL	311
14	4919	PRUESS RESERVOIR (GARRIS	241
15	4912	NEWCASTLE RESERVOIR	229
16	4916	PINEVIEW RESERVOIR	223
17	4918	PORCUPINE RESERVOIR	217
18	4925	WILLARD BAY RESERVOIR	216
19	4913	OTTER CREEK RESERVOIR	210
20	4903	DEER CREEK RESERVOIR	196
21	4920	SEVIER BRIDGE RESERVOIR	174
22	4909	MINERSVILLE RESERVOIR	168
23	4917	PIUTE RESERVOIR	165
24	4905	LYNN RESERVOIR	163
25	4914	PANQUITCH LAKE	162
26	4904	ECHO RESERVOIR	152
27	4924	UTAH LAKE	75

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY DATA

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 491 PIUTE RES.

TOTAL DRA NAGE AREA OF LAKE(SQ KM) 6319.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4917A1	6319.6	0.28	1.19	2.01	5.10	9.91	8.21	11.89	9.34	6.51	2.80	1.44	0.28	4.94
4917A2	3185.7	3.40	3.96	4.25	3.40	4.25	3.11	0.71	0.88	1.10	2.04	3.40	3.96	2.86
4917C1	2952.6	0.37	0.51	0.79	1.36	3.40	3.68	4.25	3.68	2.44	0.79	0.62	0.45	1.87
4917D1	0.0	0.0	0.0	0.0	0.028	0.057	0.085	0.085	0.085	0.057	0.028	0.0	0.0	0.036
4917ZZ	181.3	0.227	0.227	0.227	0.227	0.227	0.142	0.028	0.0	0.0	0.085	0.198	0.227	0.151

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 6319.6
SUM OF SUB-DRAINAGE AREAS = 6319.6

TOTAL FLOW IN = 59.04
TOTAL FLOW OUT = 58.98

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4917A1	11	74	1.906	10	1.954				
	12	74	0.328	14	0.125				
	1	75	0.122	11	0.125				
	2	75	0.116	15	0.125				
	3	75	0.119	8	0.113				
	4	75	2.073	5	0.125				
	5	75	9.826	8	13.451	17	14.781		
	6	75	3.228	15	8.722				
	7	75	11.950	3	10.704				
	8	75	11.525	18	13.819				
	9	75	4.814	4	8.891				
	10	75	1.727	11	1.388				
4917A2	11	74	2.917	10	3.171				
	12	74	3.540	14	3.398				
	1	75	3.823	11	3.681				
	2	75	3.681	15	3.964				
	3	75	3.285	8	3.398				
	4	75	1.470	5	1.416				
	5	75	1.314	8	0.425	17	1.529		
	6	75	3.681	15	3.087				
	7	75	1.005	3	0.396				
	8	75	0.345	18	0.232				
	9	75	0.521	4	0.311				
	10	75	1.685	11	1.104				

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4917 PIUTE RES.

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4917C1	11	74	1.158	10	1.189				
	12	74	0.790	14	1.133				
	1	75	0.467	11	0.425				
	2	75	0.405	15	0.396				
	3	75	0.459	8	0.453				
	4	75	0.484	5	0.453				
	5	75	1.798	8	1.019	17	3.851		
	6	75	4.021	15	3.313				
	7	75	4.842	3	5.012				
	8	75	1.688	18	1.444				
	9	75	1.345	4	1.331				
	10	75	1.317	11	1.331				
4917D1	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.0						
	5	75	0.028						
	6	75	0.085						
	7	75	0.085						
	8	75	0.085						
	9	75	0.057						
	10	75	0.028						
4917ZZ	11	74	0.170						
	12	74	0.198						
	1	75	0.198						
	2	75	0.198						
	3	75	0.198						
	4	75	0.198						
	5	75	0.198						
	6	75	0.170						
	7	75	0.028						
	8	75	0.0						
	9	75	0.0						
	10	75	0.085						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/12

491701
38 19 25.0 112 11 30.0 3
PIUTE RESERVOIR
49031 UTAH

150891

11EPALES 2111202
0025 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/09	09 45	0000	9.0	9.9	25	339	8.70	286	0.050	0.500	0.200	0.005
	09 45	0005	9.1	10.0		334	8.70	284	0.030	0.400	0.170	0.005
	09 45	0021	8.0	9.6		325	8.65	268	0.040	0.400	0.170	0.006
75/08/13	16 50	0000	18.4	6.8	24	492	8.00	250	0.020K	0.400	0.020K	0.009
	16 50	0005	18.2	6.4		490	8.40	256	0.020K	0.400	0.020K	0.006
	16 50	0015	18.1	6.6		500	8.45	262	0.020K	0.500	0.020K	0.045
	16 50	0025	18.0			489	8.50	292	0.020K	0.500	0.020K	0.009
75/09/24	16 15	0000	17.1	5.0	10	402	8.60	170	0.020K	0.600	0.020K	0.006
	16 15	0005	16.9	9.4		402	8.60	182	0.020K	0.800	0.020	0.006
	16 15	0013	16.4	8.4		396	8.55	164	0.020K	0.700	0.020K	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/09	09 45	0000	0.036	16.8	
	09 45	0005	0.037		
	09 45	0021	0.039		
75/08/13	16 50	0000	0.048	16.8	
	16 50	0005	0.047		
	16 50	0015	0.047		
	16 50	0025	0.045		
75/09/24	16 15	0000	0.073	55.1	
	16 15	0005	0.075		
	16 15	0013	0.081		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

491702
38 17 52.0 112 12 22.0 3
PIUTE RESERVOIR
49031 UTAH

150891

11EPALES 2111202
0036 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/09	10 30	0000	7.8	9.8	25	324	8.65	270	0.040	0.700	0.170	0.006
	10 30	0005	7.7	9.6		328	8.65	282	0.040	0.500	0.170	0.005
	10 30	0015	7.4	9.4		324	8.65	302	0.040	0.600	0.170	0.004
	10 30	0032	7.2	8.8		321	8.60	306	0.050	0.500	0.180	0.004
75/08/13	17 15	0000	18.0	6.1	18	500	8.45	276	0.020	0.500	0.020K	0.009
	17 15	0005	17.8	6.0		500	8.45	236	0.020	0.500	0.020K	0.010
	17 15	0021	17.5	3.4		501	8.30	262	0.090	0.500	0.020K	0.015
75/09/24	15 55	0000	16.0	9.4	8	391	8.60	290	0.020K	0.800	0.020	0.010
	15 55	0005	15.6	8.0		389	8.50	146	0.020K	0.800	0.050	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/09	10 30	0000	0.040	18.1	
	10 30	0005	0.039		
	10 30	0015	0.037		
	10 30	0032	0.041		
75/08/13	17 15	0000	0.054	14.6	
	17 15	0005	0.048		
	17 15	0021	0.048		
75/09/24	15 55	0000	0.103	38.9	
	15 55	0005	0.125		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

491703
38 16 30.0 112 12 04.0 3
PIUTE RESERVOIR
49031 UTAH

150891

11EPALES 2111202
0013 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/09	11 05	0000	8.3	10.6	20	338	8.80	284	0.040	1.000	0.150	0.009
	11 05	0005	7.4	9.2		326	8.65	314	0.050	0.600	0.180	0.010
	11 05	0009	7.4	9.0		325	8.65	326	0.040	0.500	0.180	0.005
75/08/12	17 40	0000	17.2	6.8	9	508	8.40	224	0.020	0.700	0.660	0.012
	17 40	0005	17.4	6.4		510	8.45	240	0.020	0.800	0.720	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/09	11 05	0000	0.058	17.0	
	11 05	0005	0.044		
	11 05	0009	0.044		
75/08/12	17 40	0000	0.110		
	17 40	0005	0.098		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/08/12

4917A1
38 19 35.0 112 11 20.0 4
SEVIER RIVER
49 15 MARYSVALE
O/PIUTE RESERVOIR 150891
BNK BELO PIUTE DAM N OF PIUTE STATE PARK
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10 55		0.048	0.900	0.022	0.010	0.070
74/12/14	12 43		0.240	1.400	0.070	0.010	0.050
75/01/11	14 00		0.384	0.300	0.030	0.005K	0.010
75/02/15	11 10		0.248	1.000	0.264	0.040	0.090
75/03/08	11 30		0.252	1.500	0.288	0.048	0.090
75/04/05	12 15		0.200	1.250	0.260	0.010	0.070
75/05/08	12 45		0.175	1.250	0.145	0.020	0.040
75/05/17	11 10		0.030	1.000	0.055	0.025	0.065
75/06/15	15 00		0.020	1.400	0.106	0.010	0.020
75/07/03	09 45		0.010	1.900	0.520	0.025	0.110
75/08/18	16 00		0.020	1.000	0.040	0.010	0.100
75/09/04	14 50		0.005	1.500	0.110	0.015	0.092
75/10/11	10 30		0.005	1.100	0.075	0.010	0.100

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4917A2
38 13 12.0 112 12 08.0 4
SEVIER RIVER
49 7.5JUNCTION
T/PIUTE RESERVOIR 150891
SEC RD BRDG 1.5 MI NW OF KINGSTON
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10 48		0.624	0.700	0.020	0.015	0.110
74/12/14	12 15		0.672	1.200	0.195	0.015	0.110
75/01/11	12 50		0.704	0.200	0.010	0.020	0.100
75/02/15	10 43		0.552	0.900	0.056	0.016	0.165
75/03/08	11 00		0.568	1.500	0.172	0.048	0.310
75/04/05	11 15		0.750	0.400	0.020		0.190
75/05/08	12 15		1.570	1.600	0.490	0.055	0.150
75/05/17	11 38		0.690	2.200	0.125	0.030	0.540
75/06/15	12 15		0.450	1.650	0.040	0.030	0.320
75/07/03	10 30		1.500	0.850	0.220	0.005K	0.020
75/08/18	16 25		0.970	0.700	0.020	0.030	0.040
75/09/04	11 50		0.010	1.700	0.020	0.030	
75/10/11	11 00		1.250	0.700	0.075	0.010	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4917C1
38 13 15.0 112 11 13.0 4
E FORK SEVIER RIVER
49 7.5 JUNCTION
T/PIUTE RESERVOIR 150891
BNK 50 FT W OF ORT RD .8 M N OF KINGSTON
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10	55	0.008	0.400	0.010	0.020	0.040
74/12/14	12	00	0.088	0.900	0.025	0.025	0.065
75/01/11	12	00	0.352	0.400	0.125	0.055	0.070
75/02/15	10	30	0.320	1.400	0.128	0.040	0.120
75/04/05	11	05	0.005	0.400	0.020	0.030	0.090
75/05/08	12	05	0.015	1.750	0.250	0.010	0.080
75/05/17	11	50	0.085	2.400	0.140	0.090	
75/06/15	12	10	0.015	1.400	0.030	0.035	0.080
75/07/03	10	35	0.020	1.200	0.060		0.060
75/08/18	16	35	0.170	1.500	0.025	0.040	0.090
75/09/04	11	45	1.200	.400	0.040	0.015	0.030
75/10/11	11	10	0.030	0.400	0.050	0.020	0.040

STORET RETRIEVAL DATE 76/08/12

491701
38 14 19.0 112 11 41.0 4
WEST CANAL
49 7.5JUNCTION
T/PIUTE RESERVOIR 150891
BNK 50 FT N OF DRT RD 2 MI E OF JUNCTION
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10	30	0.368	0.400	0.015	0.010	0.040
74/12/14	12	25	0.736	1.000	0.155	0.025	0.150
75/05/08	12	25	0.320	1.200	0.035	0.005	0.020
75/06/15	12	30	0.350	0.700	0.128	0.065	0.135
75/07/03	10	15	0.730	0.500	0.070	0.010	0.015
75/08/18	16	15	0.550	0.900	0.015	0.005	0.040
75/09/06	11	55	0.670	0.600	0.055	0.010	0.060
75/10/11	11	50	0.740	0.200	0.015	0.005K	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED